WIND.

Observations of wind direction have been made at the morning and evening hours; the results are tabulated under the heading "Winds at 8 h. and 20 h. (number of observations)" in Table 1 [omitted.] This part of the table shows the winds actually observed on the campus in the morning and evening as far as they can be determined. All wind directions at Berkeley must be estimated, as the equipment of the station does not include a vane and no accurate compass directions have been laid down on the campus. In general the observations have been made from the drift of smoke and from the flag on the campus, so that the directions must be regarded as approximations and not the actual conditions of air movement. These give fairly accurate directions for the morning hour, but the directions are more uncertain at night.

The topography of Berkeley and its vicinity probably has a strong local influence on the wind direction, which may amount to actual control in some cases. The canyon of Strawberry Creek through the western line of hills bordering the campus must have some effect on the wind direction. Although no detailed study has been made of the local air drainage, it is certain from casual observations that there is frequently in the evening a draft down from Strawberry Canyon across the campus. There are, however, no observations which show whether there is an up-canyon draft in the daytime. It would not be surprising to find that the trend of the faces of the hills and the existence of Strawberry Canyon exert a marked influence on the direction of the wind at the university campus.

CONCLUSION.

The mean annual temperature at Berkeley during the year 1912–13 was about 287°A., 57°F., with a mean annual range of 10°A., 19°F., and an extreme range of over 40°A., 70°F. The mean maximum temperature was 292°A., 66°F., and the mean minimum 281°A., 47°F. The mean monthly range was 21°A., 38°F., the mean daily range 10°A., 19°F., and the mean change from day to day 1.4°A., 2.6°F. September was the warmest month of the year and January was the coldest; January was probably abnormally cold, but no other month had a very unusual temperature. Frost was probably more frequent in December and January than the average for the whole period of the record for these months.

The pressure of the water vapor of the atmosphere was in general less than 13 millibars (10.0 millimeters or 0.4 inch of mercury), the relative humidity averaged slightly more than 80 per cent morning and night, and the mean dew point was about 275° A., 36° F., in the winter and about 286° A., 56° F., in summer. The vapor pressure and the dew point showed a strong tendency to vary with the air temperature. Not quite half the days of the year were generally clear, but only a quarter of the days were generally cloudy and many of the partly cloudy days had several hours of bright sunshine. Fog was observed on 40 days and "high fog" on about as many more, which is probably about the average for Berkeley.

The total precipitation for the year was 397.2 millimeters, 15.63 inches, which is 267.7 millimeters, 10.54 inches, less than the average. September and November had more than the average rainfall, but all the other months had less than the average. Snow fell on one day in January. There were 58 rainy days during the year, which is slightly less than the average; in five months of the year there were more than the average number of rainy days, and in five there were less than the average number, July and August being omitted from consideration, as they are generally dry. The heaviest fall of rain in any one day of the year was 60.7 millimeters, 2.39 inches, on November 6; this was the only day on which as much as 25 millimeters, 1 inch, fell. The precipitation of the year was mainly the result of 18 cyclones, the centers of most of which passed far north of Berkeley, but the cyclones were near enough to control the weather at the station.

The wind was largely from southerly and westerly directions in the average for the year, both in the prevailing directions by days and at the observation hours. The westerly element was more marked in the summer months. Calm days were rare, although no wind movement was observed at about one-fifth of the observation hours.

ELECTRIC PARAGRÊLES.[1]

By A. ANGOT, Director, Bureau Central Météorologique de France.

[Translated by R. E. Edwards from Annuaire, Soc. météorol. de France, Mars, 1914.]

It is unnecessary to review the objections that I have heretofore given against the use of cannons or rockets for protection from hail. These processes have always seemed to me to be of doubtful efficiency; but they have their origin at least in a legitimate idea, they seek to attack a thunderstorm cloud directly and to destroy it.

The electric "niagara" apparently has not even this advantage. It is founded on the erroneous idea that hail is an electrical phenomenon.

Without wishing to enter into the details of the matter, it is sufficient to point out the fact that the electrical manifestations, lightning and thunder, are not the cause of storms, but a result of much more extensive meteorological phenomena which are connected with the general circulation of the atmosphere.

The primary phenomenon is an ascending current (generally accompanied by a barometric depression) which causes the formation of a special cloud, designated cumulo-nimbus by meteorologists. In certain cases it has been possible to follow the process of the ascending air current and of the corresponding cumulo-nimbus over very large areas, such as the whole of Europe, Great Britain, and Russia.

The ascending current and the cumulo-nimbus which it produces, undergo in their progress constant modifications; the local manifestations depend on the violence of the phenomena.

Everywhere we may observe the passage of the cumulo-nimbus; over certain regions this passage will be accompanied by more or less heavy showers, phenomena less general than the cloud; in more limited regions, more serious indications will be manifested; lightning and thunder; that is, a thunderstorm and hail. But these last two indications are not necessarily associated. Thunderstorms may occur without hail or hail without thunderstorms. Admitting that a "niagara"—that is, a lightning rod—can act on electrical manifestations, we do not see what influence it could exert on a phenomenon such as hail, in whose production electricity plays no part.

Moreover, hail forms at altitudes such as seem to be not easily accessible with our means of action. In order that a hailstone may form, it is necessary that the surrounding temperature be less than 0° C. Supposing that the temperature at the ground be only 25° C., which is

[1] Extrait de la communication faite à la Société nationale d'agriculture de France, séance du 4 février, 1914.

not excessive for a summer thunderstorm, the temperature of 0° C. will be encountered at an altitude of not less than 3,000 meters and often more.

To return to the action of "niagaras" on hail; I will cite only three cases, taken from localities where the observations are unquestioned.

Since a "niagara" was installed on the Eiffel Tower, the falls of hail have not been less frequent than formerly in the quarter of the Champ-de-Mars and especially at the Bureau Central Météorologique [near the base of the Tower], where they have been observed and recorded with the greatest of care. The complete list of hail falls can be published, if necessary.

The lower station of the Observatoire de Puy-de-Dôme is situated in a freely exposed location on a plateau, in the suburbs of Clermont-Ferrand. A steel skeleton tower (pylône en fer) 31 meters high, has been constructed to carry the anemometers and is equipped with a "niagara." In the annual report of the director we read that hail fell twice on the "niagara" in 1912 and four times in 1913. Particularly on August 29, 1913, the hailstones averaged the size of a pigeon's egg and were sometimes the size of a hen's egg. Mr. Mathias concludes from his observations that "the hail-dispelling ability of the 'niagara,' theoretically improbable, has not been experimentally demonstrated."

Still more instructive observations are those of the Observatoire de Bordeaux, situated at Floirac, which was provided with a "niagara" September 22, 1912. The commune of Floirac was devastated by hail on August 15, 1887; but for the succeeding 25 years it had been immune. Again in 1912, two disastrous falls of hail occurred at Floirac, one on July 5, before the installation of the "niagara," the second on October 20, when a heavy shower of very large, hard hailstones fell upon the "niagara" itself during a period of two and a half minutes. Stones picked up 35 minutes after the fall were found to be spherical in form and opaque and on an average the size of a small pea. One of the observatory officials collected and sketched a number of very remarkable forms of hailstones that had fallen at the foot of or within less than 40 meters of the steel tower of the "niagara."

These observations show how necessary it is to be conservative in expressing appreciation of the efficiency of hail-fighting apparatus. Because there has been no hail in a place, one has no right to conclude that the processes employed, cannons, rockets, or "niagaras," have prevented the hail. A region devastated by hail may be spared for 25 years, although not supplied with any form of protection, and hail may visit it again twice in the same year a paragrêle is installed at that place.

Under these conditions, I should not recommend the extension of the system of electric "niagaras;" in my opinion there are already more than enough to continue observations which, it seems to me, must inevitably lead to negative conclusions.

On the contrary, it will be very important to have numerous exact observations on the falls of hail in France. At the present time the available stations do not enable us to draw charts showing the distribution of hail, that are sufficiently detailed to be valuable. I pointed out this insufficiency more than 10 years ago in studying the storms of 1903, and I have shown that in order to make a complete study of the distribution of hail over a small Department like the Rhône, it would be necessary to have from 280 to 300 stations uniformly distributed. A large Department like the Gironde or the Dordogne would need about 1,000 stations. These numbers suffice to show the difficulties of the problem.

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A NEW TURBIDIMETER.

By P. V. WELLS.

[Dated U. S. Bureau of Standards, Apr. 29, 1914.]

[Author's abstract.]

A systematic study of turbidity for the purpose of defining a proper standard is much needed. The paper describes an instrument in which the turbidity is measured by the light diffracted from the particles. A collimated beam from an intense source such as a Nernst or tungsten filament passes through a variable thickness of the turbid medium, and is totally reflected by a prism, thence forming a uniform beam in one field of a photometer. The diffracted light is not totally reflected, but is refracted by the prism into the other aperture of the photometer. Thus the reading is a function of the ratio of the intensities of the light scattered and transmitted, which, in turn, varies with the turbidity.

The instrument is adapted to liquids, gases, and solid plates. Minute traces are measurable with photometric precision, while the range is widened by varying the thickness of the medium. The characteristics of a preliminary instrument constructed at the Bureau of Standards are discussed.

In connection with the above, Dr. S. W. Stratton, Director, United States Bureau of Standards, writes: "It may be of interest to know that the bureau is planning to use a form of the instrument in the study of fogs as a part of the work of the [International] Ice Patrol."

THE LOWEST TEMPERATURE OBTAINABLE WITH SALT AND ICE.[1]

By ROSS AIKEN GORTNER, Physiological Chemist.

[Dated, Carnegie Instit. of Washington, Dept. Exper. Evolution.]

* * * While discussing freezing mixtures with a friend recently I stated that a temperature of −19° C. could be easily obtained and maintained for some hours with an ice and salt mixture. My friend questioned the accuracy of the thermometer, inasmuch as − 19° C. is below 0° F. (− 17.78° C.). I have, therefore, made a careful test to ascertain whether an ice and salt mixture may not show a lower temperature than 0° F.

About a gallon of finely chopped, hard ice was mixed with a quart or more of coarse salt in a water-tight wooden box, the wooden box being used because of the insulation which it afforded. The temperature was then observed with five thermometers. * * *

Thermometers 1, 2, and 3 ["Anchutz normal"] gave the same temperature for the ice and salt mixture, i. e., −21° C., which is the equivalent of 5.8° below zero Fahrenheit. Thermometer 4 was graduated only to −19° C., and the mercury was some distance below the bottom of the scale. A reading of −20° to −21° C. was made [by extrapolation]. Thermometer 5 gave a minimum of −4° F., while the Weather Bureau [minimum] thermometer (No. 6) gave a reading of −5° F. [−20.56° C.].

Previous to this experiment I had filled a wooden box holding perhaps 30 pounds of ice with a freezing mixture in the evening and placed it in an empty ice box to

[1] Extract from an article in Science, New York, Apr. 17, 1914, (N. S.), 39, p. 584-585.